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MEET THE FACULTY

Cory T. Forbes, Ph.D.

Cory Forbes is an associate professor of science education and the science literacy coordinator in the School of Natural Resources at the University



Cory Forbes

of Nebraska-Lincoln. Forbes came to UNL in 2014. He formerly was an assistant professor of science education at the University of Iowa's College of Education, Department of Teaching and Learning, Center for Global and Regional Environmental Research (CGRER).

Education:

Ph.D., Science Education, University of Michigan, 2009

M.S., Natural Resources and Environment, University of Michigan, 2009

M.S., Curriculum and Instruction, University of Kansas, 2002

B.S., Biology (Ecology and Evolutionary Biology), University of Kansas, 1999

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Water for Food
ROBERT B. DAUGHERTY INSTITUTE
NEBRASKA WATER CENTER
at the University of Nebraska

Water Current

PART OF THE ROBERT B. DAUGHERTY
WATER FOR FOOD INSTITUTE

SPRING 2015 Vol. 47, No. 2

All Seats Reserved For June Tour to Republican River Basin



N-CORPE augmentation pipeline project in southwest Nebraska.

The annual cooperative Water and Natural Resources Tour will visit the Republican River basin in Nebraska and Colorado June 23-25.

"This is a significant part of southwest Nebraska and eastern Colorado that share with Kansas the unique challenges of dividing and using the basin's limited waters," said tour co-organizer Steve Ress of the University of Nebraska's Nebraska Water Center (NWC).

"There have been substantial water use and litigation issues in the basin for many years among the three states that share its water by compact agreement. Those issues, along with

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Water for Food, Filmmaker Team On Drought Documentary

The Robert B. Daugherty Water for Food Institute at the University of Nebraska is partnering with ConjoStudios to produce "Thirsty Land," a new documentary that will share the impact of drought on agriculture.

Award-winning filmmaker Conrad Weaver of ConjoStudios will produce the new documentary that will share the impact of drought on agriculture production in the U.S. and throughout world.

The Water for Food Institute, along with UNL's Institute of Agriculture and Natural Resources, have provided startup sponsorship funds for the project. It is expected to premiere in Lincoln in conjunction with the

seventh Water for Food Global Conference in late April 2016.

"Thirsty Land" explores drought and its impact on agriculture, communities and the global food supply. It will feature expert voices from around the United States, including faculty from the University of Nebraska who specialize in drought management and preparedness, groundwater policy, irrigation technology and other water and agricultural sciences.

"We are very pleased to participate in this important documentary about the challenges of drought and climate change," said Roberto

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From the Director

Chittaranjan Ray, Ph.D., P.E.

Successful March Symposium and Water Law Conference; June Tour to Republican Basin

I want to sincerely thank all those who co-sponsored, participated in or attended the March water symposium and water law conference at NU's College of Law. These events were tremendously well received and we received very favorable comments concerning the variety of material and points of view that were presented.

One of the keys to the success of the symposium was being able to hear widely divergent perspectives on the current condition and future of the High Plains Aquifer and possible solutions on how we can help restore and maintain it for long-term sustainability for food production and for water to supply municipal, recreational and fish and wildlife needs, among other uses.

Clearly, the aquifer is increasingly critical to our abilities to feed people and sustain quality of life not only in the Midwest, but also throughout the world.

During the course of the day-long symposium, out-of-state speakers that seemed to be particularly well-received included Glenn Schur of the Texas Alliance for Water Conservation, Michigan State University groundwater researcher Anthony Kendall, and Donald Whittemore of the Kansas Geological Survey.

There was also great interest and discussions generated by the afternoon panel on "Use and sustainability of the aquifer into the future" and I want to thank Jason Farnsworth of the Platte River Recovery Implementation Program; Scott Smathers, Nebraska Sportsman's Foundation; Jim Schneider of the Nebraska Department of Natural Resources; Pat O'Brian of the Upper Niobrara White Natural Resources District; Lee Orton of the Nebraska Well Drillers Association; John Heaston of the Nature Conservancy; and Rick Kellison of the

Texas Alliance for Water Conservation for agreeing to take seats on that important panel.

We were also fortunate to have a number of very good posters on display for this

event, both from students and professional colleagues, as well as off-campus partners. First, second and third place student poster contest winners were, respectively: JoLeisa Cramer, J. Burdette Barker and Gustavo Bosch-Rubia.

At the following day's water law conference, we were extremely fortunate to have the participation of some of our very best local legal minds and practitioners of water and natural resources law in addition to keynote speaker and assistant to the solicitor General of the United States, Anne O'Connell and for the day's ethics lecture to be delivered by The Honorable James E. Doyle IV, judge of the district court, 11th judicial district, Nebraska.

I am very appreciative of Anthony Schutz's time and attentions in setting up the day's agenda and speakers.

At this point, we are planning to present the next water symposium and water law conference in the fall of 2016, returning both these events to their normal fall semester timeframe. Our first choice of venue for these events will be at our office home at the new Nebraska Innovation Campus.

Interest in next month's annual water and natural resources tour to the Republican River



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Examples of Current Research Programs:

The Modeling Hydrologic Systems in Elementary Science (MoHSES) exploratory Discovery Research K-12 project, funded by the National Science Foundation, involves three years of research and development to investigate 3rd-grade students' model-based reasoning about geospheric components of the hydrologic cycle (i.e., groundwater) and how elementary teachers scaffold students' model-based reasoning. We draw upon an existing modeling learning performances framework to guide the development and integration of a long-term conceptual modeling task into the Full Option Science System (FOSS) Water module, collaborative work with five 3rd-grade elementary teachers recruited from diverse institutional settings, and the execution of a design-based research program. We use classroom observations, in-depth interviews with students and teachers, and student artifacts to produce empirical findings, an empirically-tested learning performances framework, and pilot-tested student modeling tasks. These deliverables will ground future work to investigate students' model-based reasoning about hydrologic systems across the K-8 grades and develop an empirically-tested learn-

ing progression for elementary students' model-based reasoning about hydrologic systems.

A collaboration between USDA-NIFA, the national Agriculture in the Classroom (AIRC) program at Utah State University, and state AIRC programs from around the country, the National Center for Agricultural Literacy is positioned to change how the world thinks about agricultural systems and their science, technology, engineering, and mathematics (STEM) foundations. Center objectives are three-fold: 1) develop secondary-level curricular resources focused on STEM in agriculture and natural resource systems; 2) develop an evaluation framework and associated measures that can be used to assess AIRC program outcomes; and 3) build capacity of state-level AIRC programs by strengthening collaboration and partnerships between AIRC and higher education institutions. The Center's long-term mission is to serve as a clearinghouse for evaluation of agricultural literacy programming, leader in agricultural literacy research, and as a hub for communication between researchers, educators, producers, policy-makers, and other agricultural literacy stakeholders.

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UNL Researcher Uses Soil Moisture Detector to Help Protect South Africa's Endangered Forest

Dana Ludvik, Daugherty Water for Food Institute

A University of Nebraska–Lincoln researcher's high-tech soil moisture detector is being put to the test in the wild. Hydrogeophysicist Trenton Franz is applying technology developed for precision agriculture to help protect an endangered native forest in South Africa.

Under a National Science Foundation-supported project, Franz is working with collaborators in South Africa to help assess the environmental impacts of commercial groundwater pumping from the Venetia Diamond Mine and well fields located near Mapungubwe National Park. Franz's cosmic-ray neutron detector measures hydrogen in the park's ecosystem and detects water stress in the trees and shrubs that make up its rare gallery forest. The park, rich with biodiversity and cultural history, is located along the Limpopo River and serves as a major regional wildlife conservation area. The park's vegetation provides a safe haven for elephants, lions, hyenas, meerkats, crocodiles and more. How-

ever, the park's once dense tree canopy has become endangered due to excessive water extraction for agriculture and mining, along with damage from elephants.

"The region's semi-arid climate combined with high summer temperatures, sometimes topping 113 degrees, creates challenging growing conditions, said Franz, a Robert B. Daugherty Water for Food Institute Faculty Fellow. "Effective groundwater monitoring and management is critical for the park's plant ecosystem to survive."

In March, Franz's partners at the South African Environmental Observation Network (SAEON) and South African National Parks installed a cosmic-ray neutron detector to monitor the park's soil moisture and the amount of water inside its vegetation canopy. The device, strategically mounted on a tree out of reach of wild animals, now sends data in real time across



University of Nebraska–Lincoln researcher Trenton Franz stands next to a native tree in South Africa's Mapungubwe National Park

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Partnerships Pave Way to Solutions for Water and Food Security

Roberto Lenton and Molly Nance, Daugherty Water for Food Institute

Challenges

We need a bigger table. There will be over 200,000 more people at the global dinner table tonight than were there last night. By 2050, there will be nearly 10 billion people to feed on this planet. But our population is not only growing, it's growing wealthier, with increasing demand for food — especially meat and dairy products, requiring more agricultural production and water use. As a result of population increases and rising incomes, total food demand will likely double by 2050 (Earth Policy Institute, 2014).

Growing populations and rising incomes are just two of the constraints to ensuring food and water security for future generations. There's also the devastating effects of climate change — turning cropland into deserts, swelling crop water demands and increasing the variability of water supplies. Concerns for the sustainability of groundwater are increasing, as water tables in many parts of the world continue to fall due to over pumping. Nearly a third of the world's cropland is losing topsoil faster than new soil is forming, making land less fertile and reducing crop yields (The Globalist, 2014). And while advances in agricultural research and technology have helped improve crop production for decades, farmers in some high-potential agricultural areas have recently hit a glass ceiling — a plateau that constrains advances in the quest for more food for more people (Brown, 2012).

Holistic Solutions

To ensure sustainable global food security in the face of growing demands for scarce water resources to meet other human and environmental needs, as well as climate change, the world needs improvements in the management and use of water by and for agricultural and food systems. This enormous challenge — one of the most significant of the 21st Century — plays itself out in a variety of different contexts, from the large and highly productive systems characteristic of some major food exporting countries, to the more vulnerable smallholder producer systems in Sub-Saharan Africa and the Indian sub-continent. The availability of water for food production and other purposes, and the technology and policy options available to address the challenges, are all driven by local conditions. Hence, both the specific nature of the problems, as well as their potential solutions, differ substantially region by region, country by country, basin by basin, watershed by watershed, and farm by farm.

Despite these major differences in both problem characteristics and solutions, some of the major problems that need to be solved in our quest for greater water and food security cut across a range of contexts. For example, both large-scale farms in the major food exporting countries and smallholder producer systems in the world's poorest countries need to close yield and water productivity gaps.

Improving the sustainability of groundwater systems is proving to be a challenge in rich and poor countries alike. And both industrialized and low-income countries are grappling with ways to reconcile agricultural water use with public health needs and the allocation of water to maintain environmental services.

The Robert B. Daugherty Water for Food Institute (DWFI) at the University of Nebraska, established in 2010 through a generous \$50 million grant from the Robert B. Daugherty Foundation, was created precisely to address this need for innovation in water management in a range of different contexts across the globe. Our vision is for a food and water secure world: one in which global food security is ensured without limiting the use of water to meet other pressing human and environmental needs. Our mission is to have a lasting and significant impact on achieving more food security with less stress on scarce water resources, by conducting scientific and policy research, using the results of research to inform and advise policy makers, and educating the necessary human talent. Importantly, we work both near our home base in the center of one of the world's most important food producing areas, as well as in other parts of the globe facing significant agricultural water management challenges.

Unlike most other organizations active in this space, DWFI works to build bridges across the worlds of large-scale and small-holder agriculture, which traditionally have moved in different circles and not talked much to one another, concentrating on subject areas that are vital to water and food security both in Nebraska and globally. These subjects include:

- Yield and water productivity gaps, building on the pioneering work of the Global Yield Gap and Water Productivity Atlas, as well as the University's expertise in plant breeding and biotechnology development to improve drought tolerance and crop water productivity.
- High-productivity irrigation, working for example to use remote sensing to monitor and predict yield and water productivity levels in real time and implementing innovative projects in partnership with the private sector and social entrepreneurial groups in Sub-Saharan Africa.
- Improving groundwater management, drawing on the vast experience of Nebraska's water governance institutions and farmers, as well as the University's technical and policy expertise in the subject.
- Public health and ecosystems management, ensuring that efforts to improve water and food security also advance public health and ensure ecosystem integrity, bringing to bear the University's expertise in natural resources management, water quality analysis and technology, and public health.

Data Driven Innovation

An important path toward improving water and yield productivity is in data and technology. Harnessing the data revolution to improve water and food security from local to global scales was the theme of the Institute's sixth annual Water for Food Global Conference, held in October 2014 in Seattle. Discussions focused on examining how to use the vast array of currently available data to help farmers manage inputs and improve yields.

The explosion of data in recent years, which is having a huge impact on virtually every field of human endeavor, could potentially be an agricultural and water management game changer. Its utility stems from the patterns, trends and insights gleaned from analyzing large and diverse volumes of data, and then using those insights to make better decisions that lead to greater water and food security.

High-tech farmers generate much data on their farms. Companies are developing cloud-based tools to help them use the data and incorporate weather and other information to make decisions, such as when and how much to irrigate, as well as to automate irrigation and other farm tasks. The private sector is also taking advantage of new data tools to develop a range of products, from drought-resistant seed varieties to variable rate irrigation systems. At the other end of the spectrum, new data tools have the potential to "leapfrog" existing technologies in data-poor regions to aid smallholder farmers, much as cell phones have superseded landlines in many low-income countries. Remote sensing and digital soil mapping are becoming less expensive and could, for example, surpass costly land-based data gathering techniques.

The conference was an Americas Regional Process Event for the Seventh World Water Forum in Korea in April 2015, and the Institute has prepared a Synthesis Report (Robert B. Daugherty Water for Food Institute, 2014) as a contribution to the forum. The institute anticipates that the innovative concepts and research discussed at this conference will be continued within the Water for Food theme at the forum.

Partnerships for Solutions

One key to finding solutions to complex challenges is partnerships. From its inception, the DWFI was envisioned as developing cooperative research programs with organizations working nationally and internationally, to enable access to complementary expertise, extend its global reach, and amplify its impact, rather than trying to achieve its mission on its own. To that end, DWFI strives to keep abreast of the work of other participants — individuals, organizations, academic institutions or businesses — in its sphere of interest and collaborate with these actors where appropriate, entering

into formal agreements with several partners, from the UNESCO Institute of Water Education in the Netherlands to the International Water Management Institute (IWMI) in Sri Lanka. In carrying out its research and education and engagement activities, DWFI builds on these strategic partnerships.

We look forward to continuing the discussion and developing meaningful and measurable solutions to increasing food security with less stress on water resources with colleagues at the 7th World Water Forum in Korea.

The Robert B. Daugherty Water for Food Institute at the University of Nebraska was founded in 2010 to address the global challenge of achieving food security with less stress on water resources through improved water management in agricultural and food systems. We are committed to ensuring a water and food secure world while maintaining the use of water for other human and environmental needs.

Our approach is to extend the University of Nebraska's expertise through strong partnerships with other universities and public and private sector organizations. Together we are developing research, education and engagement programs in a focused effort to increase food security, while ensuring the sustainability of water resources and agricultural systems. We work locally and internationally, bridging the water and agricultural communities and the worlds of smallholder and large-scale farmers to deliver innovative solutions to this complex global challenge.

The University of Nebraska has invested in four interdisciplinary, University-wide institutes — including the Robert B. Daugherty Water for Food Institute — that leverage talent and research-based expertise from across the University of Nebraska system to focus on complex state, national and global challenges.

Learn more at waterforfood.nebraska.edu/.

DWFI Policy and Technical Report Series: Nebraska's Natural Resources Districts

The Robert B. Daugherty Water for Food Institute at the University of Nebraska is pleased to present its first policy report, “Nebraska’s Natural Resources Districts:

An Assessment of a Large-Scale Locally Controlled Water Governance Framework,” by Ann Bleed, Ph.D., P.E. Emeritus, and Christina Hoffman Babbitt, Ph.D.

The report is a product of the institute’s efforts to share scientific and policy research with stakeholders, furthering the institute’s mission to have a lasting and significant impact on improving food security with less stress on water resources. It is the inaugural publication in a series that will provide an in-depth, peer-reviewed report of issues involved in water and food security, including closing water and agricultural productivity gaps, ground water management, irrigated agriculture, freshwater and agricultural ecosystems, and public health.

The use of groundwater for agricultural purposes has increased significantly around the world in recent years, bringing with it important gains in yields and incomes. At the same time, however, this growth has led to rising concerns about the long-term sustainability of the resource. Water tables are dropping in many locations, largely as a result of inadequate governance that fails to ensure that groundwater withdrawals are below rates of aquifer recharge.

Against this background, good groundwater governance is being recognized as vital to ensure that the quantity and quality of the resource continues to be available to sustain agricultural systems for future generations. If properly managed, groundwater resources can play a key role in ensuring food and water security, especially in the context of a changing climate. But without good institutions, it is unlikely that societies will be able to maintain the groundwater supplies needed to meet human and environmental needs over the long-term.

Despite the recognized need for good groundwater governance, there are few real success stories in this area, particularly of effective governance frameworks covering large areas. In this context, the system of Natural Resources Districts (NRDs) in Nebraska is of significant interest. The State’s 23 NRDs, organized around river basin boundaries, are locally elected governing boards with taxing powers and authority over the regulation and management of a wide range of natural resources, including groundwater. Established in 1972, about the same time as rapid expansion of irrigation in the state, they have had the major responsibility of governing the vast groundwater resources that are so vital to Nebraska’s economy.

The significance of the governing role of the NRDs is hard to overstate. The NRD framework operates at the center of one of the world’s most important food producing regions and at a significant scale, in both land and water resource terms. There is more irrigated agriculture in Nebraska than in any other U.S. state, and more than all but a handful of the world’s countries.

Learn how Nebraska’s water governance system has helped Nebraska effectively manage this complex environmental resource and lessons learned that could be helpful as we work toward ensuring water and food security for our growing world population. The report is available online at <http://waterforfood.nebraska.edu/wp-content/uploads/2015/04/layout07b-web.pdf>. Print copies will be available for sale at the School of Natural Resources gift shop at the University of Nebraska-Lincoln or by contacting Jesse Starita, outreach coordinator, Water for Food Institute, jstarita@nebraska.edu.

Drought Documentary *continued from page 1*

Lenton, executive director of the institute. “It supports our mission by educating people about the threats, as well as the opportunities, to achieving water and food security for generations to come.”

Weaver is a video producer and president and owner of ConjoStudios, a video production company based in Frederick, Md. His most recent project is the 2014 documentary “Great American Wheat Harvest.” His work has been recognized nationally by the Telly Awards.

“The University of Nebraska is well known for being a leader in research in the areas of water, hydrology and drought mitigation,” Weaver said. “DWFI has access to world-renown researchers dealing with drought issues, so it’s exciting to be able to talk with them to see

and experience what they are doing to help farmers solve some of these complicated issues in providing more food for a growing global population.”

The Robert B. Daugherty Water for Food Institute at the University of Nebraska was founded in 2010 to address the global challenge of achieving food security with less stress on water resources through improved water management in agricultural and food systems. The institute is committed to ensuring a water and food secure world while maintaining the use of water for other human and environmental needs.

More details at: <http://www.thirstylandmovie.com/>

basin in Nebraska and Colorado has been exceptional. Within 10 days of opening general registration for the June 23-25 tour all available seats were reserved. Since the tour last visited the basin in southwest Nebraska, northwestern Kansas and eastern Colorado about seven years ago, there have been many new twists and turns in the ongoing litigation over the 1943 three-state compact that governs division of basin waters amongst Colorado, Kansas and Nebraska. Colorado and Nebraska have also developed and put in use new, controversial augmentation projects to help with compact compliance and producers and local irrigation districts have been struggling to do the best they possibly can with limited allocations of surface water for irrigation use.

All of these factors and more seem to have led to overwhelming interest in this summer's tour, which will once again be ably led by retired UNL lecturer and assistant water center director Mike Jess.

We are sure there were some people turned away from seats on the tour and we are sorry for that, but limited lodging availability in basin

communities in both Nebraska and Colorado necessitated limiting participation to no more than 60 people.

In addition to our managing co-partner, The Central Nebraska Public Power and Irrigation District in Holdrege, we want to thank this year's cosponsors for making the tour possible: The Upper, Middle and Lower Republican and Tri-basin NRDs, the Nebraska Rural Radio Association, NU's Robert B. Daugherty Water for Food Institute and UNL's Institute of Agriculture and Natural Resources.

My appreciation also goes out to Reagan Waskom, my counterpart at the Colorado State University Water Center, for his early help in identifying potential speakers, stops and issues to explore in Colorado.

Continuous updates on water center projects and programs can be found on social media at facebook.com/NebraskaWaterCenter and at twitter.com/NebrWaterCenter. Please "like" and "follow" us on those two sites and you will be kept up-to-date on the latest news and information from our center.

All Seats Reserved *continued from page 1*

surface and groundwater irrigation issues should make for a very interesting and informative tour," Ress said. The tour last went there seven years ago.

"Time to thoroughly re-examine basin issues that effect water users, producers, communities and economies in the three states that share its water."

Basin water use has been contentious since Kansas sued Nebraska in 1998 for non-compliance with the three-state compact. The 1943 compact allocates 49 percent of the river's water to Nebraska, 40 percent to Kansas and 11 percent to Colorado.

This summer's tour begins and ends in Holdrege.

On the first day, the tour stops at UNL's College of Technical Agriculture in Curtis; the N-CORPE (Nebraska Cooperative Republican Platte Enhancement) augmentation pipeline project in the Middle Republican Natural Resources District; and examines how area producers are effected by groundwater and surface water irrigation demands on available water resources. Augmentation projects have been built in both Nebraska and Colorado to help those states comply with the three-state compact, but are controversial.

There will be discussions of the terms of the compact and what producers, NRDs and others are doing, along with an overview of the Nebraska Water Balance Alliance by producer Roric Paulmann.

The tour also stops at Colorado's Bonny Reservoir augmentation project near Wray. Overnight is in Burlington, Colo.

Tour participants will hear more about basin augmentation projects on the second day, look at the U.S. Bureau of Reclamation's Swanson Reservoir and get an overview of USBR operations at their area office in McCook. A tour of Valmont Industries manufacturing facilities is also planned. Second night lodging is in McCook.

On the final day, participants will hear from surface irrigation district representatives and from producers and get an overview of the U.S. Army Corps of Engineer's Harlan County Dam, construction of which was prompted by a 1935 flood that killed more than 100 people. Lunch includes a boat ride on Harlan County Reservoir.

As the Water Current went to press, all seats for the June tour had been reserved and a waiting list was being maintained in the event of any cancellations. Inquires as to additional room on the waiting list should be sent to Holly Rahmann at The Central Nebraska Public Power and Irrigation District at (308) 995-8601 or hrahmann@cnppid.com.

Additional tour sponsors are NU's Robert B. Daugherty Water for Food Institute and Institute of Agriculture and Natural Resources, The Central Nebraska Public Power and Irrigation District, Upper Republican NRD, Middle Republican NRD, Lower Republican NRD, Tri-Basin NRD and Nebraska Rural Radio Association.

Additional information is online at watercenter.unl.edu and at facebook.com/NebraskaWaterCenter.

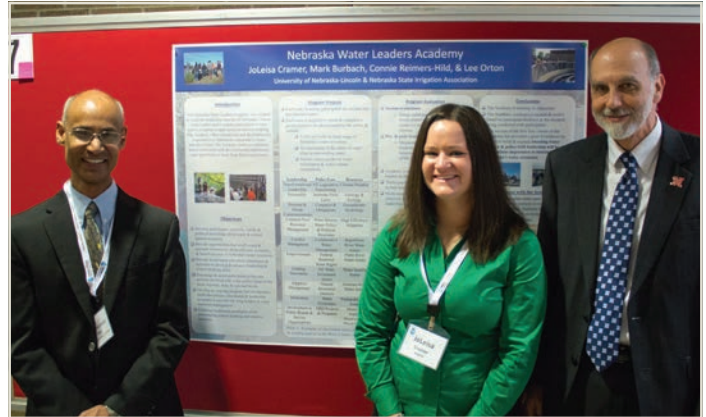
2015 Nebraska Water Center Symposium

"High Plains Aquifer: Sustainability for Food Production and Water Supply," March 19

Nebraska Water Law Conference, March 20



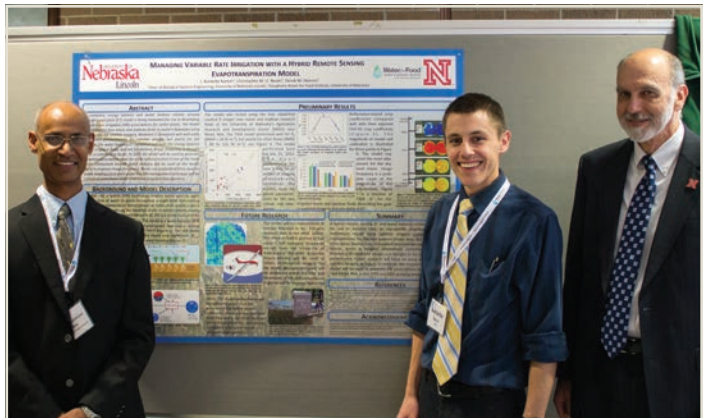
Robert B. Daugherty Water for Food Institute founding executive director Roberto Lenton opening the 2015 water symposium at the NU College of Law.



First place poster contest winner JoLeisa Cramer (center) with Nebraska Water Center director Chittaranjan Ray and IANR associate vice chancellor Ron Yoder.



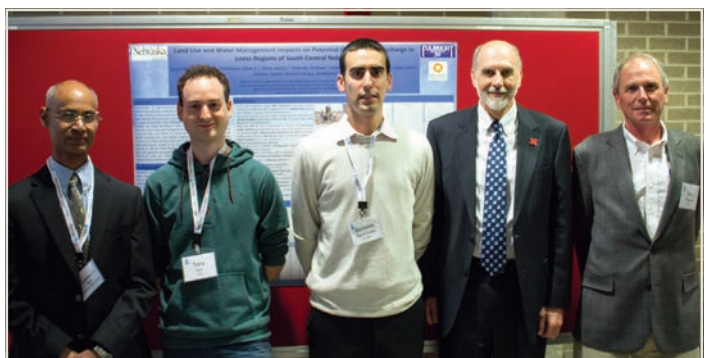
Nick Brozovic of the Robert B. Daugherty Water for Food Institute and Dan Snow of the NU Water Sciences Laboratory.



Second place poster contest winner J. Burdette Barker (center) with Nebraska Water Center director Chittaranjan Ray and IANR associate vice chancellor Ron Yoder.



The Honorable James E. Doyle IV spoke on ethics in the water law arena.



Third place poster contest winner Gustavo Bosch-Rubia (center) with (from left) Nebraska Water Center director Chittaranjan Ray, poster judge Tony Carr, IANR associate vice chancellor Ron Yoder and poster judge Tom O'Connor of the Nebraska Department of Environmental Quality.



Nebraska Water Center director Chittaranjan Ray helps open the 2015 water symposium.



Sutherland producer Roric Paulman talks about managing water for Nebraska farmers.



Anthony Schutz makes opening remarks at the 2015 Water Law Conference.



Steve Pederson of the USGS Nebraska Water Science Center talks about the critical work of modeling water flows in the Ogallala Aquifer.



Glenn Schur spoke on managing water for Texas farmers.

Water for Food Institute Students Research Water Use, Food Production

Dana Ludvik, Daugherty Water for Food Institute

Thanks to grants from the Robert B. Daugherty Water for Food Institute at the University of Nebraska, eight UNL students are working on projects to contribute to a more water and food secure world. Profiles of the students' research are now available on the institute's website: <http://waterforfood.nebraska.edu/2014-2015-student-and-postdoctoral-grantees/>. In total, the institute awarded eight grants to University of Nebraska faculty for student-led projects.

The \$310,000 grants program, which is in its first year, supports the interdisciplinary research of the institute's Faculty Fellows while enriching the education and expanding the experience of students who will one day be scientific leaders in the effort to feed the world's growing population with limited natural resources. The funding covers two postdoctoral fellows and nine graduate and undergraduate student research assistantships from July 1, 2014 – June 30, 2015. The projects range from testing the drought tolerance of wheat roots to deploying robots for aerial water sampling.

"Education is an essential part of the institute's mission," said Christopher Neale, director of research. "We are excited to roll out our student support program and help faculty and their students pursue projects that will advance the University of Nebraska's efforts to provide solutions for global water and food security."



Joseph W. Arneson

UNL students supported by the awards are:

Undergraduates

- Joseph W. Arneson, Water Science, UNL School of Natural Resources; Mariah R. Lundgren, Environmental Studies, UNL School of Natural Resources, for the Platte Basin Time Lapse Project. Faculty Fellow: Michael Farrell, assistant professor of practice, UNL Agricultural Leadership, Education and Communication.



William Avery

Graduates

- William Avery, UNL School of Natural Resources, for the project: Improving soil moisture monitoring in agricultural systems using hydrogeophysics. Faculty Fellow: Trenton Franz, assistant professor of hydrogeophysics, UNL School of Natural Resources.



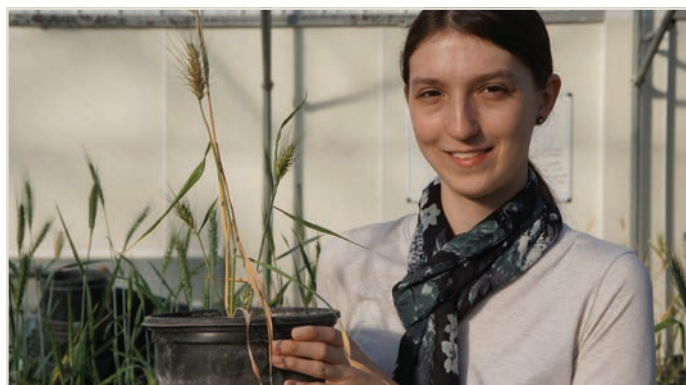
Kate Boone

- Kate Boone, UNL Agronomy & Horticulture, for the project: Revealing the links between crop production, irrigation and inter-annual changes in groundwater levels in Nebraska. Faculty Fellow: Patricio Grassini, assistant professor, UNL Agronomy & Horticulture.
- Sarah Blecha, UNL Agronomy and Horticulture, for the project: Improving drought tolerance of wheat through more adaptive roots. Faculty Fellow: Harkamal Walia, assistant professor, UNL Agronomy & Horticulture.
- James Higgins, UNL Mechanical and Materials Engineering, for the project: Enabling Sub-Surface Aerial Water Sampling for Water Management and Quality Analysis. Faculty Fellow: Carrick Detweiler, assistant professor, UNL Computer Science and Engineering.

Postdoctoral Fellows

- Lorena Castro García, UNL Biological Systems Engineering, for the project: Software Development for Water and Agriculture-resources Data and Information Access: The Case of the Water for Food Interoperability System (WaFIS). Faculty Fellow: Francisco Muñoz-Arriola, assistant professor in hydroinformatics and integrated hydrology, UNL Biological Systems Engineering and School of Natural Resources.
- Rachindra Mawalagedara, UNL Earth & Atmospheric Sciences, for the project: Leveraging DWFI Resources to Address Water for Agriculture in Latin America under a Changing Climate. Faculty Fellow: Robert Oglesby, professor in climate modeling, climate change and variability, UNL Earth & Atmospheric Sciences.

More information on the institute's 2015-2016 student support program will be available in April. To learn more, contact research and outreach coordinator Rachael Herpel at rherpel@nebraska.edu or 402.472.4977. You may also visit the website, <http://waterforfood.nebraska.edu/what-we-do/>.



Sarah Blecha



James Higgins

The Robert B. Daugherty Water for Food Institute at the University of Nebraska was founded in 2010 to address the global challenge of achieving food security with less stress on water resources through improved water management in agricultural and food systems. We are committed to ensuring a water and food secure world while maintaining the use of water for other human and environmental needs.

Learn more at waterforfood.nebraska.edu/.



Lorena Castro Garcia



Rachindra Mawalagedara



Mariah R. Lundgren



The Summer Water Tour may make a stop at the Kit Carson County Fairgrounds in Burlington, which houses a historic steam carousel (inside the building at right).



N-CORPE augmentation water in Medicine Creek in southwest Nebraska.



Swanson Lake, near Trenton, one of several impoundments on the Republican River in southwest Nebraska.



Turbine work has begun at the U.S. Army Corps of Engineers' Harlan County Dam, near Alma. The tour will stop there.



One of the Summer Water Tour's stops will be at the University of Nebraska-Lincoln's Nebraska College of Technical Agriculture in Curtis.



Bonney reservoir in eastern Colorado.

Planning the June Water and Natural Resources Tour to the Republican River Basin in Nebraska and Colorado



The Summer Water Tour will take a tour of the Valmont irrigation plant in McCook.



Rich farm ground along the Republican River near McCook.



Lower Republican NRD general manager Mike Clement and tour host Mike Jess talk about potential tour stops near Harlan County reservoir.



The Republican River near Oxford.

South Africa's Endangered Forest *continued from page 3*

the globe to Franz's lab in Lincoln, Nebraska, for analyses. Franz is working closely with SAEON hydrometeorologist Colin Everson in Pietermaritzburg to combine the data with detailed local vegetation monitoring to determine if and when the forest is being affected by water stress.

Once a mathematical relationship between the cosmic-ray neutron detector measurements and the vegetation water stress measurements has been established, the technology may be used by De Beers Consolidated Mines Limited as part of its conservation efforts. De Beers' Venetia Diamond Mine is located 10 miles from the park and relies heavily on the area's water resources to support its operations. Franz's technology has the potential to serve as an early warning system, providing information the company can use to more effectively manage its groundwater pumping and mitigate any detrimental effects on the forest.

Franz last visited South Africa in January to help with project data estimates and calibration, and to mentor two graduate students working with the technology across a range of sites in the region.

He plans to visit again in early 2016 to continue work on the project and follow-up on other research initiatives. For additional information on Franz's research, visit <http://tfranz2.wix.com/trenton-franz#!research/ca4p>. More information on the NSF grant can be found here: http://sites.nationalacademies.org/PGA/PEER/PEER-science/PGA_084069

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The University of Nebraska has invested in four interdisciplinary, University-wide institutes — including the Robert B. Daugherty Water for Food Institute — that leverage talent and research-based expertise from across the University of Nebraska system to focus on complex state, national and global challenges.

Learn more at waterforfood.nebraska.edu.



Nick Brozovic (left), director of policy for the Robert B. Daugherty Water for Food Institute, and Dan Snow, director of the Nebraska Water Sciences Laboratory, answer questions following their presentation at the March water symposium at NU's College of Law in Lincoln (DWFI photo).

NWC Social Media

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Distance from KazNU *continued from page 16*

that, like Kazakhstan, has its own uranium deposits and is impacted by uranium weathered and transported from large deposits in the Rocky Mountains. Though the element occurs naturally and is found everywhere in small amounts, elevated levels due to activities like mining can pose significant health risks, most notably to kidneys.

Because Kazakhstan's contamination is historically more pronounced and the resources to deal with it more limited, the impetus to collaborate is greater, says Shalabayev.

"Our primary goal is to visit the WSL and introduce opportunities and increase collaboration between the USA and Kazakhstan." His dissertation will focus on the evolution of radionuclides contamination in southern Kazakhstan.

For his part, Nugmanov is examining how to purify water contaminated with elevated amounts of metals like copper, tin and zinc. "My goal is to create a water quality filter using glauconite." Nugmanov hopes to use glauconite as a "Brita filter" to purify water used in uranium mining.

Fittingly, the duo was also able to visit some of Lincoln's noted tourist destinations. "We went to the Nebraska State Capitol and saw the big bison at a park." Because ice is rarely used in Kazakhstan, they also were "amazed" to be served ice water at a local Chinese restaurant.

Overall, Shalabayev says, they will leave with a good impression of Lincoln and its people: "It is a very good city. The local people are very kind, sincere and friendly."

Cory T. Forbes, Ph.D. *continued from page 3*

Teaching:

AGRI/NRES 103

Selected Publications:

- Forbes, C.T., Zangori, L., Schwarz, C.V. (in press). Empirical validation of integrated learning performances for hydrologic phenomena: 3rd-grade students' model-driven explanation-construction. *Journal of Research in Science Teaching*.
- Forbes, C.T., Vo, T., Zangori, L., & Schwarz, C. (in press). Supporting students' scientific modeling when learning about the water cycle. *Science and Children*.
- Forbes, C.T., Lange, K., Möller, K., Biggers, M., Laux, M., & Zangori, L. (2014). Explanation-construction in 4th-grade classrooms in Germany and the United States: A cross-national comparative video study. *International Journal of Science Education*, 36(14), 2367-2390.
- Forbes, C.T., Schwarz, C., & Zangori, L. (2014). Development of an empirically-based learning performances framework for 3rd-grade students' model-based explanations about hydrologic cycling. In Polman, J. L., Kyza, E. A., O'Neill, D. K., Tabak, I., Penuel, W. R., Jurow, A. S., O'Connor, K., Lee, T., and D'Amico, L. (Eds.), *Learning and becoming in practice: The International Conference of the Learning Sciences (ICLS) 2014, Volume 1*, (pp. 46-53). Boulder, CO: International Society of the Learning Sciences.

Zangori, L. & Forbes, C.T. (2014). Scientific practices in elementary classrooms: 3rd-grade students' scientific explanations for seed structure and function. *Science Education*, 98(4), 614-639.

Zangori, L., Forbes, C.T., & Schwarz, C. (2014). Investigating the effect of curricular scaffolds on 3rd-grade students' model-based explanations for hydrologic cycling. In Polman, J. L., Kyza, E. A., O'Neill, D. K., Tabak, I., Penuel, W. R., Jurow, A. S., O'Connor, K., Lee, T., and D'Amico, L. (Eds.), *Learning and becoming in practice: The International Conference of the Learning Sciences (ICLS) 2014, Volume 2*, (pp. 942-946). Boulder, CO: International Society of the Learning Sciences.

Biggers, M., Forbes, C.T., & Zangori, L. (2013). Elementary teachers' curriculum design and pedagogical reasoning for supporting students' comparison and evaluation of evidence-based explanations. *The Elementary School Journal*, 114(1), 48-72.

Forbes, C.T., Biggers, M., & Zangori, L. (2013). Investigating essential characteristics of scientific practices in elementary science learning environments: The Practices of Science Observation Protocol (P-SOP). *School Science and Mathematics*, 113(4), 180-190.

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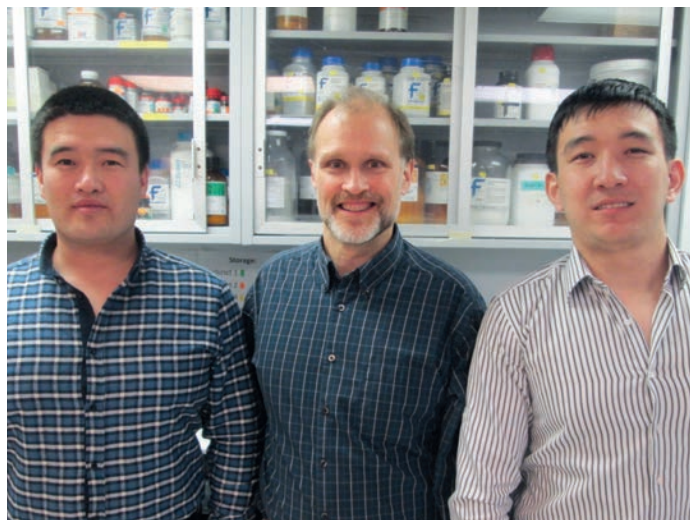
Distance From KazNU to UNL Continues to Shrink

Jesse Starita, Daugherty Water for Food Institute

The distance separating Almaty, Kazakhstan and Lincoln, Nebraska – some 6,500 miles – continues to shrink thanks to a burgeoning partnership in water sciences nurtured by researchers on both continents.

Last September, Dan Snow, director of the Nebraska Water Center's Water Sciences Laboratory (WSL), and Alan Kolok, a biology professor at the University of Nebraska, Omaha and director of the Nebraska Watershed Network, traveled to Kazakhstan to share a little of what they have learned about biology and chemistry in a nine-day ecotoxicology workshop at Al-Farabi Kazakh National University, affectionately known as Al-Farabi KazNU.

To build on that momentum, Al-Farabi KazNU chemistry graduate students Zhandos Shalabayev and Samgat Nugmanov spent 10 days at UNL in February, learning about the similarities and differences between river basins in Kazakhstan and Nebraska. In the fall 2014 issue of the Nebraska Water Center's Water Current newsletter, Snow and Kolok wrote how "Both regions face enormous and complex water quality issues...across wide geographies that can dramatically vary over time."



Zhandos Shalabayev, Dan Snow of the NU Water Sciences Laboratory and Samgat Nugmanov (Jesse Starita, Daugherty Water for Food Institute).

As the world's largest landlocked country – its span east to west equals that of New York to Los Angeles – Kazakhstan is also a leading producer of uranium ore. Nebraska too is a large, landlocked area

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